Cottam Solar Project

Outline Battery Storage Safety Management Plan

Revision ~~A~~B

Prepared by: Lanpro and Island Green Power

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Outline Battery Storage Safety Management Plan
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1 Executive Summary

1.1.1 This report has been prepared on behalf of Cottam Solar Project Ltd. (the 'Applicant') in relation to an application made to the Secretary of State (SoS) for the Department for Business, Energy & Industrial Strategy (BEIS), under section 37 of the Planning Act 2008, seeking a Development Consent Order (DCO) for the Cottam Solar Project (the 'Scheme').

1.1.2 The Scheme is a nationally significant infrastructure project comprising a ground mounted solar photovoltaic generating station with a gross electrical capacity of over 50 megawatts and associated development including an Energy Storage Facility. The DCO Application (including the Environmental Statement [APP-035 – APP-058] assumes that the form of energy storage will be battery storage and as such, the Energy Storage Facility (as it is termed in the draft DCO Schedule 1), is often referred to as a 'BESS' (Battery Energy Storage System throughout the application documents). The Scheme is to be located at four distinct areas, as described in Chapter 3 of the Environmental Statement (ES) [APP-038].

1.1.3 The DCO Application proposes that the BESS for the Scheme will be located within Cottam 1. Two options are proposed for the BESS (within Work No. 2 and Work No. 3 as shown on the Works Plans [AS-007]).

1.1.4 Illustrative Site Layout Plan, Cottam 1, West A [APP-154]. shows the BESS. Illustrative Site Layout Plan, Cottam 1 West B [APP-155] shows additional areas for BESS. If Option A were pursued (the smaller option), a more extensive area for solar panels can be provided. If Option B is pursued, a smaller area for solar panels will be provided.

1.1.5 The solar array Sites, associated substations and BESS are to be connected to the National Grid at a substation at Cottam Power Station. This report outlines the key fire safety provisions that are considered likely to be included in the design of the proposed BESS facilities.

1.1.6 Prior to the commencement of construction of the BESS, Cottam Solar Project Ltd. will be required to prepare a Battery Storage Safety Management Plan (BSSMP) which must be in accordance with this Outline BSSMP. As part of the BSSMP, the Applicant will take into account the latest good practices for battery fire detection and prevention, along with the emergency response plan, as guidance continues to develop in the UK and around the world.

1.1.7 There are several battery storage technologies available to system designers. The generic system used for indicative planning purposes is a 750 KWh BESS "cabinet" system integrating two battery racks. - The BESS design and system chemistry type is still to be determined, but it will be a lithium-ion battery cell type. The popular types of this chemistry within the lithium-ion family are Lithium Nickel Manganese Cobalt Oxide ($LiNiMnCoO_2$) known as "NMC" after the three key active materials or Lithium Iron Phosphate ($LiFePO_4$) known as "LFP". The final battery chemistry will be confirmed as part of the detailed design prior to the commencement of construction.

1.1.8 For the purposes of this document a concept design has been considered that uses a BESS system based upon LFP lithium-ion battery technology that is currently used on other sites being developed by the Applicant. This is considered to be a reasonable worst case for the purposes of the assessment in terms of BESS toxic gas emission potential (Hydrogen Fluoride production) and explosion risk (significant levels of hydrogen produced during thermal runaway).

1.1.9 The BESS will be designed in accordance with the UK and internationally recognised good practice guidance available at the time.

1.1.10 The overall approach is to follow the Health and Safety Executive's (HSE) hierarchy of controls:

- Elimination;
- Substitution;
- Engineering Controls;
- Administrative Controls;
- Personal Protective Equipment (PPE).

1.1.11 This document details the types of safety systems available on the market at present, along with risk reduction barriers which are likely to be incorporated into the system to be installed at the Sites. It is possible that by the time of construction that all solid-state batteries, or other battery technologies may be available. This will be reflected in the BSSMP approved by the Local Planning Authorities in consultation with the HSE, Lincolnshire Fire and Rescue Service and the Environment Agency.

1.1.12 A summary of the anticipated fire safety provisions are as follows:

- The BESS will be designed, selected, and installed in accordance with international guidance, good practice, and related standards.
- Risk assessments will be carried out for the entire system and elements across the project lifecycle.
- The specific location of the BESS will be chosen to minimise impacts on receptors (albeit this is inherent in the DCO Application as it has been factored in tointo the design process to date).
- Separation distances between components will be selected to minimise the chance of fire spread based on best practices.
- Equipment will, where possible, be selected to be fire limiting, such as selection of transformer oils with low flammability and the fire resistance of the BESS enclosures. The BESS facility will be designed with multiple layers of protection to minimise the chances of a fire or thermal runaway event.

- All equipment will be monitored, maintained, and operated in accordance with manufacturer instructions.
- The BESS facility will include integrated fire and explosion protection systems. Following industry good practice (e.g., NFPA 855 2023) or based on 3rd party fire and explosion testing, gas venting systems will avoid build-up of explosive gases. A site-specific Emergency Response Plan (ERP) will be developed for the BESS post consent, based on national and international best practice measures.
- 24/7 monitoring of the system via a dedicated control facility. The control facility will have the capability to shut the system down should the need arise and will also be responsible for implementing the emergency plan and acting as a point of contact for the emergency services.
- Communication with the local fire & rescue services (FRS) with engagement early in the project and continuing across design and construction phases. This will ensure a robust emergency plan and material is available in an emergency.

2 Introduction

2.1 Scope of this Document

2.1.1 This outline BSSMP document, produced by the Applicant, outlines the key fire safety provisions for the BESS proposed to be installed at Cottam Solar Project including measures to reduce fire risk and fire protection measures.

2.1.2 This document provides a summary of the safety related information requirements which will be provided in advance of construction of the BESS. The purpose of this outline BSSMP is to identify how the Applicant will use good industry practice to reduce risk to life, property, and the environment from the BESS.

2.1.3 Prior to the commencement of construction of the BESS, the Applicant will be required to prepare a BSSMP which must be in accordance with this outline BSSMP. As part of preparation of the BSSMP, the Applicant will take into account the latest good practices for battery fire detection and prevention, along with the emergency response plan, as guidance continues to develop in the UK and around the world.

2.1.4 As the operational phase is anticipated to commence no earlier than 2026, reference to current measures and guidelines are included here. However, this document will be updated prior to construction of the BESS to take account of prevailing guidance.

2.2 Project Description

2.2.1 For the purposes of this document a concept design has been considered that uses a BESS based upon LFP lithium-ion battery technology that is currently used on other sites being developed by the Applicant. This is considered to be a reasonable worst case for the purposes of the assessment in terms of safety.

2.2.2 The design of the BESS and its impact are controlled in several ways. Prior to commencement of construction of the BESS, a BSSMP (in accordance with the Outline BSSMP) is required to be submitted to the relevant local planning authority and approved, in consultation with the HSE, Lincolnshire County Fire and Rescue Service and the Environment Agency. The Applicant must operate the BESS in accordance with the approved plan.

2.2.3 Further, pursuant to a requirement of the Development Consent Order (DCO), the detailed design of the BESS must be in accordance with the Outline BSSMP (which includes various safety requirements for the BESS design) and the Concept Design Parameters and Principles document [REP-039]. The Concept Design Parameters and Principles contain controls over the BESS, which include that the chemistry of the BESS will be lithium-ion.

2.2.4 The concept design consists of the BESS containers and the associated transformers, circuit breakers and inverters. The BESS, containers, and auxiliary system, such as cooling, uninterruptible power supply (UPS), fire and gas detection systems, monitoring and control, will be designed in accordance with national and international BESS standards and best practice guidance available at the time.

2.2.5 Once operational, the plant will be designed to operate unmanned with access required for maintenance only, and with a minimum Operational Life of 40 years.

2.3 Potential BESS Failure

2.3.1 Causes of battery cell failure which could lead to a thermal runaway event include manufacturing defects (contaminants / imperfections), electrical abuse (overcharging/ over-discharging), and physical or mechanical damage (puncture / crushing).

2.3.2 BESS hazards for first responders in the unlikely event of a battery failure and thermal runaway event depend on the BESS design but are typically defined as: fire hazards, explosion hazards, electrical hazards (shock or arc flash), and chemical hazards (i.e. the release of toxic gases). First responders will wear full PPE and remove all jewellery, fire management should not generally be conducted within any exclusion zones identified by the fire and rescue services.

2.3.3 Regardless of the type of failure or the cause, the main potential hazard is thermal runaway and ultimately, if not controlled, a ~~-~~significant flaming or explosive gas venting incident~~-~~ and therefore this report focusses on reducing fire and explosion risks associated with the BESS and managing the hazard in the unlikely event that it occurs.

2.3.4 Other electrical systems than the batteries which form part of the BESS can carry fire risks, however due to the extensive historic long-term deployment of other technology such as transformers, inverters and switchgear, these risks are better understood and regulated, through longstanding industry guidance and codes. Therefore, only the battery component of the BESS is addressed in this report.

2.4 Safety Objectives

2.4.1 The safety objectives for the design of the BESS are:

- To minimise the likelihood of an event. This is an overriding priority;
- To minimise the consequences should an event occur;
- To restrict any event to the BESS site and minimise any impact on the surrounding areas;
- To automatically detect and begin to fight a fire as soon as possible;
- To ensure any personnel on Site are able to escape safely away from the Site;
- To ensure that firefighters can operate in reasonable safety where necessary;
- BESS design and site layout should minimise the requirement for direct Fire and Rescue Service (FRS) intervention in a thermal runaway incident i.e. direct hose streams or spray directly on BESS battery systems. FRS intervention in worst case scenarios would ideally be limited to boundary cooling of adjacent BESS and ESS units to prevent the fire from spreading. This strategy should be

finalised with the Lincolnshire Fire & Rescue (LFR) and be clearly communicated in the Emergency Response Plan (ERP).

- If the BESS system is designed to safely burn out to remove the risk of stranded energy in the battery systems, then full scale free burn testing will have been conducted to demonstrate that loss will be safely limited to one container without the intervention of the LFR.
- To ensure that fire, smoke and any release of toxic gases do not significantly impact site operatives, first responders and the local community.
- To ensure that firewater run-off is contained and treated.

2.5 Relevant Guidance

2.5.1 Guidance documents and standards considered by the Applicant have been used to inform the design of the scheme.

2.5.2 There is currently limited UK specific guidance for BESS, however the Applicant has incorporated good practice from around the world.

2.5.3 The Applicant has developed the BESS in accordance with all relevant legislation and good practice. This document takes into account the recommendations of the following good practice documentation used in the UK for similar sites, including:

- National Fire Chiefs Council (NFCC) Grid-Scale Battery Energy Storage System planning – Guidance for FRS (2023).
- National Fire Protection Agency (NFPA) NFPA 855 (2023) .
- NFPA 68: Standard on Explosion Protection by Deflagration Venting.
- BS EN 14797 (2006): Explosion venting devices.
- NFPA 69: Standard on Explosion Prevention Systems.
- Underwriters Laboratories (UL) UL 9540A (2019) Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems.
- UL 1642 (2020): Standards for Lithium Batteries.
- UL 1973 (2022): Batteries for Use in Stationary and Motive Auxiliary Power Applications.
- UL 9540 3rd Edition (2023): Standard for Energy Storage Systems and Equipment.
- FM DS 5-33 (2023) FM Global Datasheet. Lithium-Ion Battery Energy Storage Systems.
- United Kingdom Power Networks (UKPN) Engineering Design Standard 07-0116: Fire Energy Storage Systems, 2016

- DNV GL-Recommended Practice-0043: Safety, Operation and Performance of Grid-Connected Energy Storage Systems, 2017.
- Scottish and Southern Energy TG-PS-777: Limitation of Fire Risk in Substations, Technical Guide, 2019.
- BS 5839 Part 1 2017: Fire Detection and Fire Alarm Systems for Buildings
- The Regulatory Reform (Fire Safety) Order (RRO) 2005.
- BS EN IEC 61936, Power installations exceeding 1 kV AC and 1,5 kV DC – AC.
- BS EN IEC 62619 (2017) Secondary cells and batteries containing alkaline or other non-acid electrolytes. Safety requirements for secondary lithium cells and batteries, for use in industrial applications.

3 Consultation

3.1 Lincolnshire Fire and Rescue

3.1.1 The local fire and rescue service, Lincolnshire Fire and Rescue (LFR) has been consulted during pre-application discussions and as part of the Section 42 Statutory Consultation exercise.

3.1.2 A formal written response was received from LFRSLFR on 9th September 2022. This states:

"LFR recognises the use of batteries (including lithium-ion) as Energy Storage Systems (ESS) is a new and emerging practice in the global renewable energy sector. As with all new and emerging practices within UK industry the Service would like to work with the developers to better understand any risks that may be posed and develop strategies and procedures to mitigate these risks."

3.1.3 Further comments made by LFR in their responses are set out in the table below.

Table 6.1 Lincolnshire Fire and Rescue Recommendations

Lincolnshire Fire and Rescue Recommendations
Procuring components and using construction techniques which comply with all relevant legislation
The inclusion of Automatic Fire Detection systems in the development design
Including automatic fire suppression systems in the development design. Various types of suppression systems are available, but the Service's preferred system would be a water misting system as fires involving Lithium-ion batteries have the potential for thermal runaway. Other systems would be less effective in preventing re-ignition.
Including redundancy in the design to provide multiple layers of protection.
Designing the development to contain and restrict the spread of fire through the use of fire-resistant materials, and adequate separation between elements of the Battery Energy Storage System (BESS).
Developing an emergency response plan with LFR to minimise the impact of an incident during construction, operation and decommissioning of the facility.
Ensuring the BESS is located away from residential areas. Prevailing wind directions should be factored into the location of the BESS to minimise the impact of a fire involving lithium-ion batteries due to the toxic fumes produced.
The BESS facilities should be designed to provide: - Adequate separation between containers. - Provide adequate thermal barriers between switch gear and batteries, - Install adequate ventilation or an air conditioning system to control the temperature. Ventilation is important since batteries will continue to generate flammable gas as long

as they are hot. Also, carbon monoxide will be generated until the batteries are completely cooled through to their core. - Install a very early warning fire detection system, such as aspirating smoke detection/air sampling. - Install Carbon Monoxide (CO) detection within the BESS containers. - Install sprinkler protection within BESS containers. The sprinkler system should be designed to adequately contain and extinguish a fire. - Ensure that sufficient water is available for manual fire-fighting. An external fire hydrant should be located in close proximity of the BESS containers. − The water supply should be able to provide a minimum of 1,900 l/min for at least 120 minutes (2 hours). Further hydrants should be strategically located across the development. These should be tested and serviced at regular intervals by the operator. If the site is remote from a pressure feed water supply, then an Emergency Water Supply (EWS) meeting the above standard should be incorporated into the design of the site e.g. an open water source and/or tank(s). If above ground EWS tanks are installed, these should include facilities for the FRS to discharge (140/100mm RT outlet) and refill the tank. - The site design should include a safe access route for fire appliances to manoeuvre within the site (including turning circles). An alternative access point and approach route should be provided and maintained to enable appliances to approach from an up-wind direction. - As the majority of BESS are remotely monitored, consideration should include the fixing of an Information Box (IB) at the FRS access point. The purpose of the IB is to provide information for first responders e.g. Emergency Response Plan, to include water supplies for firefighting, drainage plans highlighting any Pollution Control Devices (PCDs) / Penstocks etc for the FRS.

3.1.4 The Applicant subsequently met with the LFR on 4th October 2022 to discuss specific design measures to incorporate into the Scheme. These are discussed further below.

4 BESS Safety Requirements

4.1 Safe BESS Design

4.1.1 The BESS will be designed to address prevailing industry standards and good practice at a time of detailed design and implementation. BESS system and components used to construct the facility will be certified to UL 9540 (2023) standards (or any future standards which supersede this).

4.1.2 As a minimum, the battery system will have completed unit or installation level UL 9540A testing, demonstrating that thermal runaway propagation will not spread between modules or between battery racks and the generation of explosive gases will not threaten container structural integrity. This offers a high level of protection against fire and explosion risk.

~~4.1.3~~ NFPA 855 (2023) currently provides the most comprehensive guidelines for BESS design and site installation specifications. BESS design structural integrity will be demonstrated through full-scale fire and explosion testing or by integrating NFPA 69 (explosion prevention) and NFPA 68 (Explosion protection through deflagration venting) features.

4.1.4 A BESS fire suppression system, if integrated by the BESS Original Equipment Manufacturer (OEM), will conform to NFPA 855 (2023) guidelines, and the suppression system should be tested to UL 9540A latest standard or significant scale third party fire and explosion testing~~. If a BESS enclosure is a container design (20 ft, 40 ft, 53 ft), a fire suppression system will need to be integrated.~~. The current trend for BESS cabinet systems is not to integrate automatic fire suppression systems and to demonstrate that a worst-case scenario is the safe burn out of a single BESS cabinet without fire brigade intervention, decommissioning is an easier process if stranded energy (live battery modules) risks are removed. In the majority of these BESS cabinet designs a dry pipe sprinkler system is installed for the LFR to operate if they believe that internal suppression is required during a thermal runaway event. BESS site water supply capability must factor in additional volume for this potential requirement. If a BESS enclosure is a container design (20 ft, 40 ft, 53 ft), a fire suppression system will probably need to be integrated unless a full free burn test has shown that both fire and explosive events can be safely contained. If the BESS enclosure is a walk-in design, a fire suppression system must be installed. As best practice, fire suppression system performance should be benchmarked against free burn testing and a minimum of three suppression tests should be conducted. An independent Fire Protection Engineer (FPE) specialising in BESS should review all UL 9540A test results and any additional fire and explosion test data which has been provided and validate the suppression system design.

4.1.5 NFPA 855 (2023) confirms water is the most effective battery fire suppression agent and, therefore if a BESS Fire Suppression System (FSS) is integrated, a water-based system will be considered for each BESS enclosure designed to control or fully suppress a fire without the intervention of ~~the FRS~~LFR . The suppression system must be capable to operate effectively in conjunction with a gas exhaust/ventilation system to minimise deflagration risks. System design and water supply requirements must be fully agreed with the FRSLFR.

4.1.6 If the BESS system is designed to safely burn out without internal fire suppression systems (to remove the risk of stranded energy in the battery systems), full-scale free burn testing will be conducted to demonstrate that loss will be safely limited to one container without the intervention of LFR. Tesla Megapack, Fluence Cube, and Wartsila GridSolv Quantum BESS cabinet systems have all conducted UL 9540A and 3rd Party full scale free burn testing to validate safe equipment spacing and demonstrate that deflagrations do not occur or can be safely constrained. UL 9540A heat flux test data can also establish safe distances between containers and ESS equipment but will not be conclusive if full propagation of the battery system does not occur in the test. As best practice, additional third party3rd Party fire and explosion testing should be utilised by the BESS Original Equipment Manufacturer (OEM) to demonstrate that structural integrity is maintained and toxic gas emissions to the closest receptors are below Public Health England (PHE) guidelines when the battery system is fully consumed (burnt out). An independent Fire Protection Engineer specialising in BESS will review all UL 9540A test results and any additional 3rd Party fire and explosion test data which has been provided and share conclusions with LFR i.e. the need for additional water supply for boundary cooling or a dry pipe sprinkler system.

4.1.64.1.7 As best practice, additional Third Party fire and explosion testing should be utilised by the BESS OEM to demonstrate that structural integrity is maintained and toxic gas emissions to the closest receptors are below Public Health England (PHE) guidelines when the battery system is fully consumed in a thermal runaway event. An independent Fire Protection Engineer specialising in BESS should review all UL 9540A test results and any additional third partyThird Party fire and explosion test data which has been provided and share conclusions with the LFR.

4.1.74.1.8 In addition to this, good practice guidance for electrical sites within the UK has been consulted with regards to Site layout and separation distances for the transformers and inverters.

- Safety Certifications and mitigation features typically found within battery module design, which the Applicant will commit to for the Scheme, include: Internal fuses;
- Liquid cooling system
- Active thermal management system
- Contactor at rack/string and bank level;
- Overcharge safety device;
- Internal passive protection products;
- Venting systems and gas channels;

- Thermal or multi-sensor monitoring devices.

4.1.84.1.9 Battery cell certified to UL 1973 and tested to UL 9540A unit or installation level for BESS designs.

4.1.94.1.10 Module design will be certified to UL 1973 and tested to UL 9540A unit or installation level.

System Location

4.1.104.1.11 Within the Cottam Site the selection of the location of the BESS has been based on a number of factors. The most pertinent factor being the selected Site has tried to minimise the proximity to receptors of any nuisance with the distance to properties maximised where possible. This has the benefit of reducing the visual and noise impact but also minimises any potential impacts on the local population should an event occur. The location of the proposed BESS is more than 320m from any residential properties.

System Layout

4.1.114.1.12 The layout of the system will provide separation between key components or groups of key components.

4.1.124.1.13 The BESS will be broken into discrete groups consisting of battery containers and inverters and transformers. Each group will be separated from the next. This separation will limit any fire that is not able to be contained to the affected group or part of the battery system and also allow emergency access in case of an intervention.

4.1.134.1.14 National Fire Protection Agency (NFPA) 855 (2023) defines basic operation Health & Safety (H&S) protocols for all BESS site designs which should be incorporated into emergency response plans:

- Potential debris impact radius is defined as 100 feet (ft) or 30.5 metres (m) i.e. this is a typical explosion risk safe exclusion zone radius as modelling and previous BESS incidents typically show 25 m to be maximum radius.
- Automatic building evacuation area is defined as 200 ft or 61 m from the affected BESS enclosure.

4.1.144.1.15 The separation distance between the battery enclosures and Order limits boundary will be a minimum of 15 metres.

4.1.154.1.16 The separation of the inverters and transformers will, depending on the architecture and volume of oil, be optimised at detailed design stage to minimise the likelihood of any spread of fire between adjacent components.

4.1.164.1.17 The layout of the Scheme provides adequate separation between enclosures, additional ESS (Energy Storage System) equipment, and other key site structures and infrastructure. The UK National Fire Chiefs Council (NFCC) 'Grid Scale

Battery Energy Storage System planning – Guidance for FRS (2023)' will be followed at an indicative design stage, which comprises:

- To protect BESS enclosures from exterior risks, they shall be provided with impact protection to prevent damage to battery enclosures by vehicles or construction equipment and use Damage Limiting Construction (DLC) techniques.
- Where practical, a minimum separation distance of 6m between BESS enclosures and ESS equipment, as stated in NFCC guidelines. This exceeds the NFPA 855 (2023) guidelines of 3m, considered safe practice if sufficient UL 9540A testing and/or third partyThird Party fire and explosion testing heat flux data has validated that closer spacing does not increase explosion risks or fire propagation risk. The current concept design allows for 3m spacing and the Applicant will therefore provide sufficient UL 9540A testing and/or 3rd Third Party Fire and Explosion testing heat flux data to the council and FRSLFR as part of the final safety management plan, or otherwise revert to the 6m spacing.
- NFCC guidelines allow reduced separation distances if suitable design features can be introduced. If reducing distances, a clear, evidence-based case for the reduction will be shown in the detailed design phase and supported by heat flux test data i.e. UL 9540A unit or installation testing and / or third partyThird Party fire and explosion testing.
- Areas within 10m of BESS enclosures do not contain combustible vegetation and would not be planted with any new combustible vegetation wherever possible. Where this is not feasible a full risk assessment would be conducted, and mitigation features applied if required by the FRSLFR. Any other vegetation on site would be kept in a condition such that they do not increase the risk of fire on site.
- The BESS enclosure would have an internal fire resistance rating of at least one hour (according to NFPA 855, BR 187 and FM Global Datasheet 5-33).
- The BESS area would be designed to integrate fire hydrants and/or static water tanks for firefighting, dependent on available water supply. Water tanks will be located at least 10m from the nearest BESS enclosure. Water access points, whether hydrants or tank connections, would be located in consultation with the LFRSLFR to provide redundancy and safe operating distances for firefighters with 30 – 50m, which is considered an optimal safe distance.
- Tanks and water outlets would be clearly labelled with appropriate signage and marked on site plans. Additionally, to avoid any mechanical damage, outlets and hard suction points would be safeguarded with bollards.

4.1.174.1.18 By adhering to the separation distances noted above, risk should be adequately minimised to limit a fire event to a single BESS or ESS structure.

Battery System Enclosures

4.1.184.1.19 Battery enclosures will house the battery systems, , electrochemical components and associated equipment. Being either one, or multiple containers joined, or close coupled to each other. They will be mounted on a concrete foundation.

4.1.194.1.20 The BESS enclosure will be installed by a certified and qualified installer. The BESS enclosure will be UL9540 certificated. Ingress protection testing of BESS enclosures is conducted under UL9540 and/or IEC62933-5-2 certification of any BESS system. Typical BESS enclosure ingress protection levels are IP55 / NEMA 3R or IP66 / NEMA 4NEMA4. IEC Factory Acceptance Testing (FAT) or an independent manufacturing audit will be carried out to ensure the supplied BESS enclosures comply with the requisite certified ingress protection levels.

4.1.204.1.21 Ingress Protection[1] (IP) ratings of BESS containers will be shared with LFR at the detailed design stage so that risks associated with boundary cooling can be understood and implemented into the ERP. Potential boundary cooling water ingress points such as Heating, Ventilation and Air Cooling (HVAC) systems and deflagration vents will be considered as part of an incident response strategy.

4.1.214.1.22 The BESS enclosures will be locked to prevent unauthorised access and, will have an internal fire resistance rating of at least one hour (according to NFPA 855, BR 187 and FM Global Datasheet 5-33).

4.1.23 Where required, BESS enclosure walls will have a minimum one--hour fire resistance rating to BS EN 13501-2 and BS EN 1364-1 standards.

Fire Detection and Suppression

4.1.224.1.24 In order to achieve the safety objectives, the Scheme will employ monitoring systems that will help identify any abnormal operation and safely shutdown the system before it develops, these systems will be independent of the control systems and equipment that can cause the abnormal event and avoid the use of Safety Integrity Level (SIL) rated risk controls. Other measures include:

- Thermal monitoring of the battery containers and automated cut-out beyond safe parameters;
- Battery cooling systems with automated fail-safe operation;
- Emergency Stop – both remote and local;
- The fire and gas detection system for the Scheme will comply with NFPA 855 (2023) and NFPA 69. This means that smoke, fire and gas detection equipment

[1] Ingress Protection (IP) rating grade the resistance of an enclosure against the intrusion of solids or liquids.

will be installed on site. New BESS multi-sensor equipment in development which measures combinations of air temperature, hydrogen, volatile organic compounds, overpressure, shock and vibration, and moisture ingress will also be considered if fully tested with the BESS design. The gas detection systems will have external BESS beacon and audible alert facility. The final fire detection design will be validated by an independent Fire Protection Engineer under the responsibility of the Operations, Engineering and Maintenance Contractor prior to construction, and will be approved by -LFR.

- The BESS fire suppression system will conform to NFPA 855 (2023) guidelines, and the suppression system will be tested to UL 9540A latest standard or significant scale third party fire and explosion testing. Fire suppression system performance will be benchmarked against free burn testing. An independent Fire Protection Engineer specialising in BESS will be contracted by the Operations, Engineering and Maintenance Contractor to review all UL 9540A test results and any additional fire and explosion test data which has been provided and validate the suppression system design.
- NFPA 855 (2023) confirms that water is the most effective battery fire suppression agent, therefore a water-based system will be considered for each BESS enclosure designed to control or fully suppress a fire, without the intervention of the FRSLFR. The suppression system will be capable of operating effectively in conjunction with a gas exhaust / ventilation system to minimise deflagration risks. System design and water supply requirements will be fully agreed with LFR.
- A post-incident recovery plan shall be developed, as recommended by the NFCC guidance that addresses the potential for reignition of BESS battery systems, as well as removal and disposal of damaged equipment. A fire watch will be present until all potentially damaged BESS equipment batteries are removed from the area following a fire event. The water supply for suppression systems and / or firefighting will be replenished as quickly as feasible.
- Energy Storage Management Systems / Battery Management Systems (ESMS / Battery Management System (BMS) controls will follow NFPA 855 (2023) recommendations (new IEC and IEEE standards are being drafted). Battery system data analytics will be integrated into ESMS / BMS systems and controls which reduces Thermal Runaway risks. Data Analytics can also be used to predict accurate End-of-Life timeframes and provide operator maintenance alerts.
- Other measures to minimise the risk of a fire event that could be implemented include:
- Any ventilation and gas extraction system will be designed to exhaust flames and gases safely outside in case of fire inside the BESS enclosure, without compromising the safety of first responders. The ventilation system shall be

provided with suitable ember protection to prevent embers from penetrating BESS enclosures (HVAC, gas exhaust, deflagration panels).

- As a minimum, a BESS ventilation system will comply with NFPA 855 (2023) / NFPA 69 guidelines which require the prevention of a dangerous build-up of explosive gases (25% LEL). The gas exhaust / ventilation system must have redundancy and can be separate to any HVAC system providing climate control. Heating and cooling of the battery modules will be provided by an independent liquid cooling system which is separate to any HVAC system providing climate control for the BESS enclosure. When mechanical ventilation is required to maintain concentrations below the required limits, it shall be interlocked, so that the system shuts down upon failure of the ventilation system.
- Where emergency ventilation is used to mitigate an explosion hazard, the disconnect for the ventilation system should be clearly marked to notify personnel or first responders to not disconnect the power supply to the ventilation system during an evolving incident.
- The BESS enclosure will be designed to withstand overpressures generated by the battery system during thermal runaway. An explosion prevention system to NFPA 69 standards and / or explosion protection system to NFPA 68 and BS EN 14797 standards will be integrated. If BESS design only integrates explosion protection systems i.e. deflagration panels, then performance must be validated through BESS free burn testing and requisite pressure testing required by NFPA and EN standards. Further, the BESS enclosure will have completed UL 9540A unit and / or installation testing or large-scale 3rdThird Party Fire and Explosion testing without pressure waves occurring or shrapnel being ejected. An independent Fire Protection Engineer specialising in BESS will review all UL 9540A test results and any additional fire and explosion test data which has been provided.

4.2 Safe BESS Construction

4.2.1 The BESS would be constructed in 2 distinct phases. Firstly, the civil works and balance of plant equipment would be started. Then at a suitable point the BESS equipment would be delivered to be installed on the foundations and connected to the balance of plant.

4.2.2 The installation would be subject to pre-requisites such as a contractor emergency protocol detailing the actions to be taken in an emergency, including a construction emergency response plan that would be coordinated with the relevant stakeholders and emergency services. In addition, installation would not take place until practical provisions were completed such as the water tanks being installed and filled for use in an emergency.

4.2.3 The transportation of the system from the factory will be a combination of sea and land freight. The system is certified for transportation in all potential environmental conditions. The equipment will be certified for transport to UN 38.3. Transportation will be managed in accordance with the European Agreement Concerning the International Carriage of Dangerous Goods by Road (ADR) 2019 and the UK guidance on the transport of dangerous goods "Moving dangerous goods, Guidance" Government webpage (Ref 1- 4).

4.2.4 The appointed contractor will ensure the transported BESS equipment will be prepopulated with batteries and will have undergone Factory Acceptance Testing (FAT) to IEC 62933-5-2 standards. Site Acceptance Tests (SAT) will follow IEC 62933-5-2 and IEEE 2962 (in development) standards and protocols.

4.2.5 By following a logical sequence of works with each step being built upon the preceding one the system can be safely assembled without risk and all mitigations against issues in place before the next step occurs.

4.3 Safe BESS Operation

Control Room

4.3.1 The BESS will be monitored by the on-Site control systems as well as 24/7 monitoring by a remote-control room.

- Staff will be fully trained and familiar with the BESS technologies and will be responsible for alerting -LFR and for connecting -LFR with BESS incident Subject Matter Experts (SMEs).
- A 24/7 remote control facility will monitor the security of the BESS site, and monitoring and detection systems will be repurposed in an emergency to support first responders. NFPA 855 (2023) defines the minimum monitoring and control standards.
- The 24/7 control facilities will have the capability to immediately shut the system down should an incident occur, and the need arise. It will also implement the ERP, acting as a point of contact to the emergency services.
- In some circumstances it will be necessary to discharge the batteries to enable the first / second responders to deal with the incident. This capability could potentially be achieved through the remote facility (24/7). The precise methodology in this regard will be agreed in the ERP once the detailed design of the BESS is known. This will be prepared in conjunction with LFR and is secured through this document.
- The control room will also be responsible for the security of the Site with state-of-the-art detection and monitoring systems. These can be repurposed in an emergency to support first responders.
- The control room will have the ability and authority to immediately shut the system down should the need arise.
- The control room will be responsible for the implementation of the emergency plan acting as a point of contact to emergency services.

- Signage should be installed in a suitable and visible location on the outside of the BESS units, identifying the presence of a BESS system. Signage would be as per NFCC guidelines and will also include details of:
    a) Relevant hazards posed i.e., the presence of High Voltage DC Electrical Systems is a risk, therefore their location should be identified.
    b) The type of technology associated with the BESS.
    c) Any suppression system fitted.
    d) 24/7 Emergency Contact Information.
    e) Signs on the exterior of a building or enclosure will be sized such that at least one sign is legible at night at a distance of 30m or from the site boundary, whichever is closer.

Control Architecture

4.3.2 NFPA 855 (2023) stipulates that a BMS should at a minimum provide the following safety functions:

4.3.3 High cell temperature trip to isolate the module or rack when detecting cell temperatures that exceed limits.

4.3.4 Thermal runaway trip to isolate the battery system when a cell is detected to have entered a thermal runaway condition.

4.3.5 Rack switch fail-to-trip to disconnect the rack if any failure is detected. Inverter/charger fail-to-trip to isolate the BESS enclosure at the breaker if the inverter/charger fails to respond to a trip command.

4.3.6 Inverter/charger fall-to-trip (supervisor level): This function initiates a trip command to an upstream breaker to isolate the ESS if the inverter/charger fails to respond to a trip command. The 'supervisor' control system controls the entire system, including the combination of racks, the environmental support systems, and the charging/discharging status. The supervisor level should isolate the ESS if the inverter/charger fails to trip on an appropriate signal, or if communication is disrupted between the inverter/charger and the supervisor control.

4.3.7 The BMS should, at minimum, incorporate NFPA 855 (2023) monitoring and control features. Three new IEEE standards are in development (IEEE P2686, IEEE P2688 and IEEE P2962) which cover BESS data analytics, electrical controls and maintenance/replacement of battery components/systems. These standards should be adopted by the BESS system provider once the standards are published.

4.3.8 If data analytics are not directly integrated by the battery OEM or BESS integrator, the Applicant will ensure a Data Analytics package is integrated to provide a greater range of performance and safety data i.e. predict ageing of the cells in battery systems, alert BMS faults or malfunctions, identify electrical abuse during operations, alert the operator when modules need maintenance or decommissioning. Data Analytics facilitate more accurate assessment of operating temperature variations, voltage anomalies, State of Charge (SOC), and State of Health (SOH). Data Analytics can also monitor complimentary BESS safety features i.e. smoke and gas sensors, BESS multi-sensor equipment, ground fault detectors, etc.

4.3.9 Cybersecurity will form a fundamental part of the system design and architecture as there is an increasing focus in this area from national and international regulatory bodies. International standards such as IEC 62443, UL 1741, IEEE 1815, and IEEE 1547.3 will be consulted and guidance from national sources such as National Cybersecurity Centre inform the implementation and protection measures. Reference should be made to the Health and Safety Executive (HSE) Operational Guidance document OG86.

4.3.10 UL– published 'UL 2941 (2023) Outline of Investigation for Cybersecurity of Distributed Energy and Inverter-Based Resources'. UL 2941 provides testable requirements for photovoltaic inverters, electric vehicle chargers, wind turbines, fuel cells and other resources essential to advancing grid operations. These new requirements prioritise cybersecurity enhancements for power systems that deal with high penetration inverter-based resources, including those interfacing with bulk power systems for periods of instantaneous high wind, solar and hybrid/storage generation. UL 2941 promotes the necessity to have cybersecurity designed into new inverter-based resources (IBR) and distributed energy resource (DER) systems, and the BESS system supplier at the detailed design stage will conform to these requirements.

Security

4.3.11 The site security profile will be assessed by an on-call team with dedicated service level agreement in place with input from all local key safety stakeholders. The package of security measures will be agreed with this stakeholder group.

4.3.12 Where practical and required by the local FRS orLFRor risk assessment, the BESS area will have security fencing with a minimum of two points of ingress / egress for first responders and will be clearly signed, with incident emergency response contact details, clear identification of BESS site hazards, details of site access arrangements such as key codes, which will be provided to the FRSLFR.

4.3.13 The Scheme will also have Thermal Imaging Cameras to alert and locate on site fire risks and integrate high definition CCTV with video analytics to alert and respond to unauthorised site access.

Maintenance

4.3.14 The BESS will be maintained and operated by skilled personnel ensuring that the system is in optimal condition and that all parts of the system are fully serviced and functional at all times.

4.3.15 Routine maintenance will be undertaken on the BESS equipment every 6-12 months depending on the risk profile of equipment. This typically consists of a major maintenance period and a minor maintenance period. This will encompass all BESS and supporting equipment supplied by the Original Equipment Manufacturer (OEM) including the fire protection and explosion prevention system. Minor maintenance is typically a visual inspection and rectification of any accumulated noncritical defects.

4.3.16 All maintenance will be undertaken in a carefully controlled manner following the Site safety rules and in accordance with the Operational Environmental Management Plan (OEMP) [EN010133/EX2/C7.16_A] submitted in support of the Application.

4.3.17 During operation of the BESS facility, all works on the site will be controlled under safe systems of work. This will mean all work is risk assessed to protect both personnel and equipment. Therefore, safety systems such as fire systems or battery monitoring systems will not be stopped or taken out of service without appropriate mitigation, following the system being made safe so far as reasonably practicable, and only for the minimum time required to undertake any specific maintenance tasks.

4.3.18 The operation of the BESS will be managed in accordance with the OEMP.

End of life/Disposal

4.3.19 With regards to the decommissioning of the BESS, the requirements will be determined at the procurement contract stage, with the contractor remaining clear that they are the producer of the battery components and the party placing the battery components on the UK market pursuant to the Waste Batteries and Accumulators Regulations 2009 (as amended) and pursuant to the Waste Batteries and Accumulators Regulations 2009 (or such equivalent regulations in force at the time of decommissioning) (Ref 1-5) it has certain obligations in respect of battery disposal.

4.3.20 All components replaced during the defects notification and warranty period will be taken back and recycled.

4.3.21 The Applicant will follow the hierarchy of waste management through the life of the Scheme as follows:

- Reduce – the lithium-ion batteries have finite life based on a number of factors, primarily the total number of cycles undertaken. The operation will attempt to manage the degradation by the selection of services and cycling that maximises the overall life. Consideration will be given to supplementation of the equipment or operation at a lower output.
- Recycle – The supplying manufacturer will have obligations under the Waste Batteries and Accumulators Regulations 2009 (as amended) (or such

equivalent regulations in force at the time of decommissioning) and will be contractually obliged to offer a recycling service.

- Recovery – The recycling should allow any useful materials to be recovered and re-enter the supply chain.
- Disposal – Any disposal of batteries shall be undertaken in compliance will all applicable laws and all regulatory requirements, product stewardship, registration disposal and recycling or take back requirement.

5 Firefighting

5.1 Fire Service Guidance

5.1.1 Guidance for the Fire Service for dealing with sites such as powerplants, substations etc. is contained in the Fire Service Manual Volume 2 Fire Services Operations – Electricity (Ref 1-6).

5.1.2 The Fire Service Manual stipulates that in all cases involving electrical apparatus, it is essential to ensure, on arrival, that the apparatus is electrically isolated and safe to approach. This should be carried out by the operator at the premises concerned. It is strongly advised that electrical or associated equipment should not be touched or even approached unless it is confirmed to be isolated and safe.

5.1.3 In the event of a fire, the battery system and the transformers serving the BESS will be automatically electrically isolated when a fire is detected within a container. However, the batteries within the containers will still hold charge in the event of a fire, even after the electrical system is isolated. It will not be possible to confirm that there is no residual risk from the energised batteries within the container, and this will inform the strategy for firefighting in the emergency plan.

5.1.4 If a dedicated automatic water-based system is provided within each BESS container this will be designed to control or fully suppress a fire, without the direct intervention of LFR.

5.1.5 The Applicant has engaged with Lincolnshire Fire and Rescue (lFR) throughout the pre-application phase, which has led to a number of design improvements, which are set out below.

5.2 Fire Service Access

5.2.1 Access will be designed such that emergency services are able to access the Site easily with Site roads being clearly laid out and signed in accordance with the following:

5.2.2 Turning facilities will be provided in any dead-end access route that is longer than 20m. The minimum proposed access-route width to reach the BESS will be 4m.

5.2.3 At least two separate access points to the site to account for opposite wind conditions / direction. If the Scheme site is not able to accommodate this requirement due to topographic limitations, then alternative site-specific ingress / egress arrangements will be agreed with LFR.

5.2.4 Road networks on sites will enable unobstructed access to all areas of the BESS facility.

5.2.5 A swept path analysis for emergency vehicles has been undertaken and the roads have been confirmed as suitable for emergency vehicle access.

5.3 Fire Water

5.3.1 The Concept Design Parameters and Principles [REP-039], for the Scheme include the following for water storage structures for the purposes of fire fighting.

- External firefighting water storage structures will be located no less than 50m and no more than 300m from the battery containers.
- The external firefighting water storage units will be no less than 228000 litres in capacity.
- Water storage will either be in sectional steel panel tanks, or cylindrical steel tanks, above or below ground; or will be bunded or excavated ponds.
- Where above ground, tanks will be supported on structural concrete slab foundations to a maximum depth of 1m.
- The BESS scheme will integrate both internal Fire Suppression System (primary containment) and external fire fighting water capture drainage (secondary containment). Pollution analysis should be conducted before removing from site (if polluted) or releasing into drainage systems, if safe to do so. Internal Fire Suppression System water run-off is likely to contain higher levels of pollution compared to external firefighting water used for boundary cooling.

5.3.2 The Illustrative Site Layout Plans for Cottam 1, West A [EN010133/APP/C6.4.4.3] and Cottam 1 West B [EN010133/APP/C6.4.4.4] show the potential locations of the water storage facilities (tanks or ponds).

5.3.3 The following requirements from the NFCC guidance will also be taken into account:

- In order to determine the volume storage of external water supplies for firefighting, NFCC guidance will be used which states provisional firefighting supplies “should be capable of delivering no less than 1,900 litres per minute for at least 2 hours.” LFR will be able to view the selected BESS system fire test data and an independent Fire Protection Engineer will validate the final water supply requirements. A BESS design which may require direct LFR firefighting engagement tactics will not be selected for this facility.
- Site and BESS design principles and ERP content will ensure that the FRS are expected to employ a defensive strategy i.e., only boundary cooling should be employed for cooling of adjacent BESS or associated supporting equipment.
- Water storage tanks designed to be used for firefighting will be located at least 10m away from any BESS enclosure. They must be clearly marked with appropriate signage. They will be easily accessible to LFR vehicles and their siting should be considered as part of a risk assessed approach that considers potential fire development/impacts. Outlets and connections should be agreed with LFR. Any outlets and hard suction points should be protected from mechanical damage (e.g., through use of bollards).

5.4 Emergency Planning

5.4.1 The BESS will have a robust and validated emergency plan, developed in consultation with Lincolnshire Fire and Rescue (LFR).

5.4.2 Some example BESS and site design information which is anticipated to be shared with LFR to establish a risk profile for first responders, are listed below:

- Battery chemistry integrated into BESS – can provide fire and explosive risk profile.
- Battery form factor (cylindrical, pouch, prismatic).
- Battery energy Wh / KWh – confirmation of new vs second life cells.
- Battery module cooling system details (e.g., liquid cooling design, air cooling design) – cooling system capability assessment to stop or reduce battery cell thermal runaway propagation.
- Battery module vent or gas exhaust specifications.
- Battery module KWh energy + number of cells contained in the module + battery circuitry details (number of cells in series vs number of cells in parallel).
- Direct suppression system details – module or rack level integration.
- Rack design – number of modules and KWh energy, spacing between modules, passive protection features, gas exhaust features, electrical isolation functions, heat or thermal runaway sensor integration, etc.
- Rack configuration – spacing to adjacent racks, number of racks in BESS, spacing to walls, doors, gas vents and roof.
- Type of BESS design e.g., container or cabinet, gas exhaust / ventilation features, deflagration vent design features, BESS enclosure level fire protection & suppression system details (proof of testing with BESS design + test data), additional fire or explosion protection features i.e., thermal barriers.
- EMS / BMS data monitoring capabilities and incident response integration capacity.
- Number of BESS containers/cabinets on site.
- Size and MWh capacity of each BESS unit.
- BESS and ESS equipment spacing; spacing to other equipment, boundaries, vegetation, roads or access routes, fire hydrants / water tanks, site building structures, etc.
- Access routes, observation points, turning areas, ~~FRS~~LFR equipment & assets, water supply locations and capacity, drainage, and water capture design.
- Definition and frequency of BESS equipment testing and maintenance requirements.
- Digital provision of safety information and procedures must be provided to site operatives, first responders and SMEs during BESS incident response –

hard copy printed materials must be available onsite (location agreed with ~~LFRS~~LFR). As a minimum content should include:

- Digital emergency response plans.
- Remote emergency shutoff procedures.
- SDS / Hazardous material documentation.
- Maps or design drawings.
- Gas detection capabilities; could include multi-sensor data metrics e.g., Carbon Dioxide (CO2), Carbon Monoxide (CO), Hydrogen (H2), VOC off gas and overpressure and local temperatures.
- Fire protection system data e.g., temperature, alarming, suppression status, etc. – establish discharge warrantee clauses, emergency BESS venting procedures, discharge times, impact on ventilation and detection systems, etc.
- ERP training drills for site operatives + ~~FRS~~LFR engagement (site familiarisation + training drills) and SME engagement (fire protection experts or battery experts)
- Other documentation as required by specific BESS project i.e., local response stipulations, contact information for nominated response personnel, community contacts, etc.

5.4.3 An ERP will be developed post planning consent to facilitate effective and safe emergency response. It will follow UK National Fire Chiefs Council (NFCC) and NFPA 855 guidelines and will include as a minimum:

- How the fire service will be alerted and incident communications and monitoring capabilities.
- Facility description, including infrastructure details, operations, number of personnel, and operating hours.
- Site plan depicting key infrastructure:
    - Site access points, internal roads, agreed access routes, observation points, turning areas, etc.
    - Firefighting facilities (water tanks, pumps, booster systems, fire hydrants, fire hose reels etc).
    - Water supply locations and capacity.
    - Drainage and water capture design and locations.
- Details of emergency resources, including fire detection and suppression systems and equipment; gas detection; emergency eyewash and shower facilities; spill containment systems and equipment; emergency warning systems; communication systems; personal protective equipment; first aid.

- Up-to-date contact details for facility personnel, and any relevant off-site personnel that could provide technical support during an emergency.
- A list of dangerous goods stored on site.
- Site evacuation procedures.
- Site operation Emergency Management protocols - four phases: discovery, initial response / notification, incident actions, resolution and post incident actions / responses.
- Emergency procedures for all credible hazards and risks, including building, infrastructure and vehicle fire, wildfires, impacts on local respondents, impacts on transport infrastructure.
- The operator will develop a post-incident recovery plan that addresses the potential for reignition of the BESS and de-energizing the system, as well as removal and disposal of damaged equipment.

5.4.4 A Risk Management Plan shall be developed with LFR post consent at the detailed design stage which, as a minimum, will provide advice in relation to potential emergency response implications including:

- The hazards and risks to the facility and their proposed management.
- Any safety issues for firefighters responding to emergencies at the BESS facility.
- Safe access to and within the facility for emergency vehicles and responders, including to key site infrastructure and fire protection systems. Establish response times and site arrival protocols.
- The adequacy of proposed fire detection and suppression systems e.g., water supply on-site.
- Natural and built infrastructure and on-site processes that may impact or delay effective emergency response i.e., firefighting water runoff capture.

5.5 Firefighting Consequences

5.5.1 As the BESS will not have personnel access into the battery enclosures~~-~~, there is unlikely to be any immediate threat to life, only property which forms part of the Scheme.

5.5.2 The emergency services would most likely commit to fighting fire by using water on neighbouring areas such as battery enclosures~~-~~, trees, and structures to cool down and prevent further fire spread.

5.5.3 It is not anticipated that firefighting techniques will require direct hose streams or spray directly on battery systems and will be limited to boundary cooling of adjacent BESS units and supporting equipment to prevent the fire from spreading. This strategy will be finalised with the LFR and be clearly communicated in the ERP.

5.5.4 A BESS fire could result in the mobilisation of pollution within surface water run-off. As set out in the Hydrology, Flood Risk and Drainage Chapter 10 of the ES [APP-045], where practical, at detailed design stage it is recommended that runoff from the battery storage area will be contained by local bunding and attenuated within gravel subgrade of lined permeable SuDS features prior to being passed forward to the local land drainage network. In the event of a fire a system of automatically self-actuating valves at the outfalls from the battery storage areas will be closed, isolating the battery storage areas drainage from the wider environment. The water contained by the valves can then be tested and either treated and released or tankered off-site as necessary and in consultation with the relevant consultees at the time.

5.5.5 Chapter 17 of the ES Air Quality [APP-052] (and associated Appendices) assesses the battery fire emission impact on the surrounding area (including residential receptors).

5.5.6 Based on the factors of distance to the nearest property and the short-term nature of a fire incident, the assessment concludes that there will not be adverse effects at the closest receptor locations as a result of a BESS thermal runaway incident. Notwithstanding, whilst there is low risk of adverse effects at the closest receptors, the emergency response plan (ERP) produced at the detailed design stage (template outlined in section 5.4.3) will incorporate all necessary emergency response procedures and actions based upon thermal runaway test data supplied by the BESS system provider.

6 Pre-Construction Information Requirements

6.1 Summary

6.1.1 The detailed design phase of the Scheme will consider the lifecycle of the battery system from installation to decommissioning. At the detailed design stage, risk assessment tools will be utilised together with detailed consequence modelling to provide a comprehensive site operations and emergency response safety audit.

6.1.2 The battery system mitigation measures adopted in a final Battery Safety Management Plan, will reflect the latest BESS safety codes and standards applicable at that stage. Mitigation measures will be discussed and coordinated with LFR.

6.1.3 A Failure Modes and Effects Analysis (FMEA) of the BESS will be conducted to lay the foundation for predictive maintenance requirements and complement the fault indicator capabilities of the BMS data analytics system.

6.1.4 Comprehensive Hazard Mitigation Analysis (HMA) will be conducted by a BESS specialist independent Fire Protection Engineer following NFPA 855 (2023) guidelines and recommendations.

6.1.5 Additional risk assessments likely to be conducted at the detailed design stage are Fire Risk Analysis (FRA), Explosion Risk Analysis (ERA), Hazard and Operability Analysis (HAZOP). BESS 3rd Party risk analysis is sometimes automatically provided by Tier one BESS manufacturers and / or BESS integrators.

6.1.6 If the BESS system supplied differs from the specification considered for risk assessments and consequence modelling, then a full safety audit will be repeated for the new BESS system specification. These studies will be completed and signed off before construction commences.

6.1.7 The detailed design phase will determine the approach to addressing the following specific requirements, which will be updated prior to construction of the BESS and submitted to the local planning authority as a detailed BSSMP prior to the commencement of construction. The detailed BSSMP must include:

- The detailed design, including drawings of the BESS;
- A statement on the battery system specifications, including fire detection and suppression systems;
- A statement on operational procedures and training requirements, including emergency operations;
- A statement on the overall compliance of the system with applicable legislation;
- An environmental risk assessment to ensure that the potential for indirect risks (e.g., through leakage or other emissions) is understood and mitigated;

- An emergency response plan (ERP) covering construction, operation and decommissioning phases developed in consultation with Lincolnshire Fire and Rescue (LFR), to include the adequate provision of firefighting equipment on-Site.

6.1.8 Provision of the above information will demonstrate prior to construction that all of the considerations and requirements in this document have been addressed and the BESS installation is safe.

6.1.9 Safe decommissioning of the BESS will be addressed prior to decommissioning of the Scheme in a Decommissioning Environmental Management Plan, and in accordance with the Outline Decommissioning Statement [APP-338] submitted as part of the DCO Application.

7 Conclusion

7.1 Summary

7.1.1 The Applicant is committed to developing a safe BESS that will provide long dependable operation. It is in everyone's interest that the selected BESS technology is robust, in particular with regards to safe operation.

7.1.2 This report demonstrates that, the Applicant has relevant experience of BESS systems; that the relevant stakeholders have been consulted (and their responses have informed the design of the Scheme), and therefore safety will be inherent in the overall design, minimising the risk of a fire event occurring, and reducing the impact of such an event should it occur.

References:

Ref 1-1: NFPA (2020) NFPA855 Standard for the Installation of Stationary Energy Storage Systems.

Ref 1-2: UL Standard (2020) UL9540A Energy Storage Systems and Equipment.

Ref 1-3: Richard Chitty (2014) External fire spread: building separation and boundary distances (BR 187 2nd edition).

Ref 1-4: https://www.gov.uk/guidance/moving-dangerous-goods

Ref 1-5: UK Statutory Instruments (2009) The Waste Batteries and Accumulators Regulations 2009.

Ref 1-6: Fire and Emergency Planning Directorate (1998) Fire Service Manual Volume 2: Fire Service Operations, Electricity.